

Controversies in Extubation

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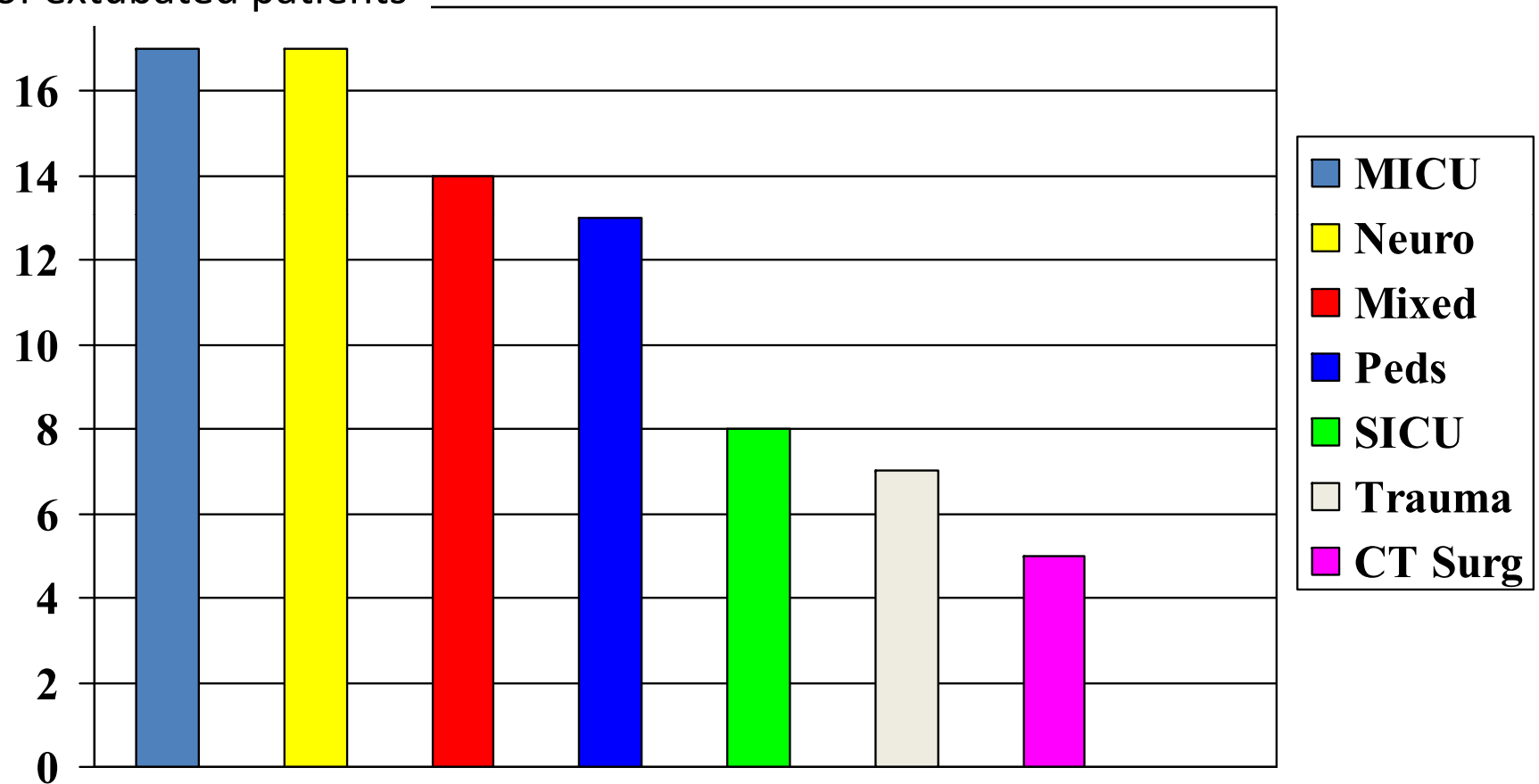
Tufts
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School of Medicine

Critical Care Canada Forum
Toronto, 2009

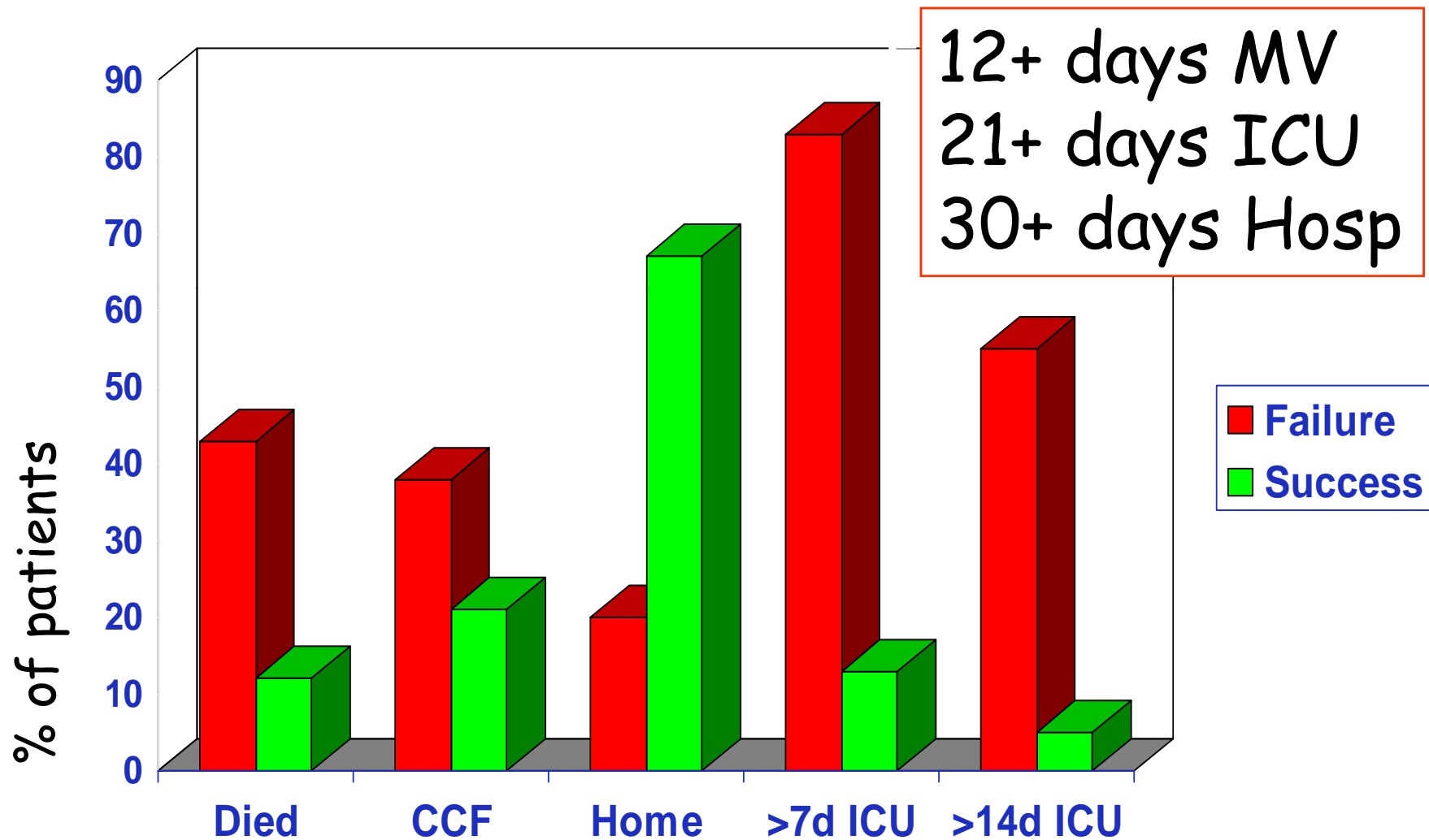
Extubation Failure

% of extubated patients



N~35,000 (60 studies)

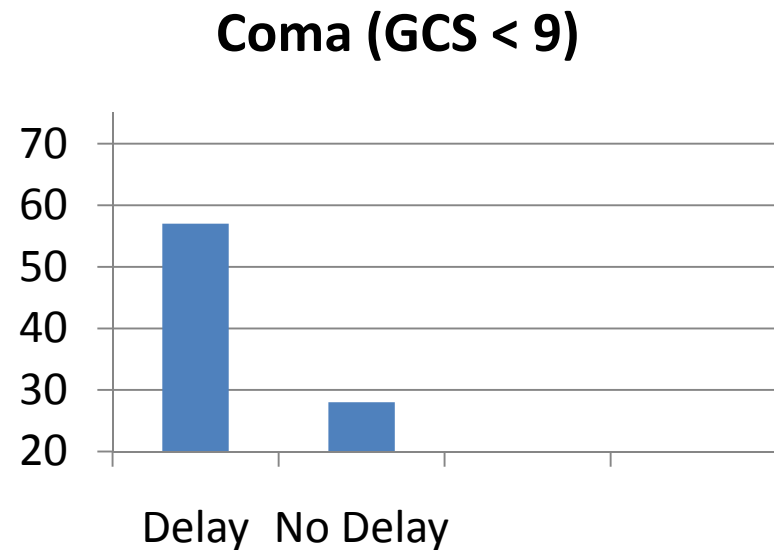
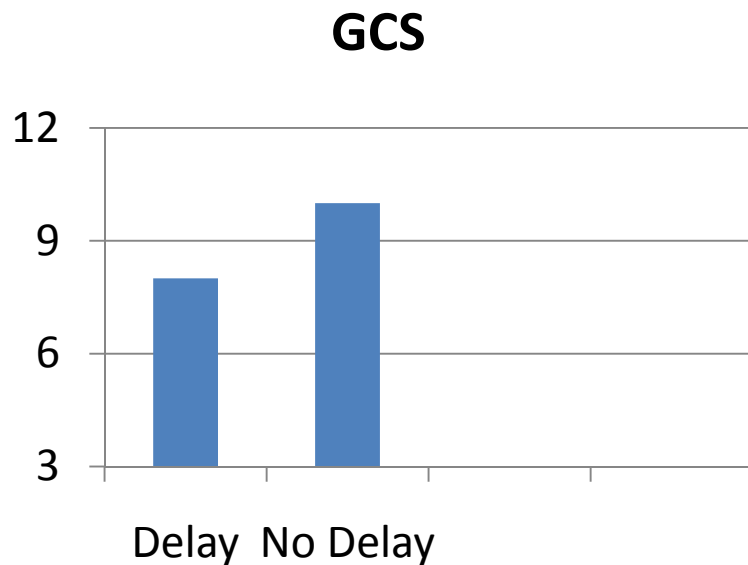
Outcome for Extubation Failure



Epstein Chest 1997

Do intubated patients need to follow commands before extubation?

- Abnormal Mental Status delays extubation & prolongs MV
 - Arias-Rivera *Crit Care Med* 2008, Namen *Am J Resp Crit Care Med* 2001, Girard *Lancet* 2008
 - Coplin, *Am J Resp Crit Care Med* 2000



Do intubated patients need to follow commands before extubation? YES

- **Kollef**, Chest 1998, Continuous IV Sedation
 - MICU=242, 15% CIVS v. 5% w/o CIVS
 - Sens 0.67, Spec 0.64, LR+ 1.9
- **Pronovost**, JQI 2002, agitated/confused/sedated
 - SICU=186; 21% v. 6%
 - Sens 0.36, Spec 0.89, LR+ 3.3
- **Ely**, JAMA 2003, RASS shift prior to extubation
 - RASS -3 (EF) v -2 (ES), p=.07

Do intubated patients need to follow commands before extubation? YES

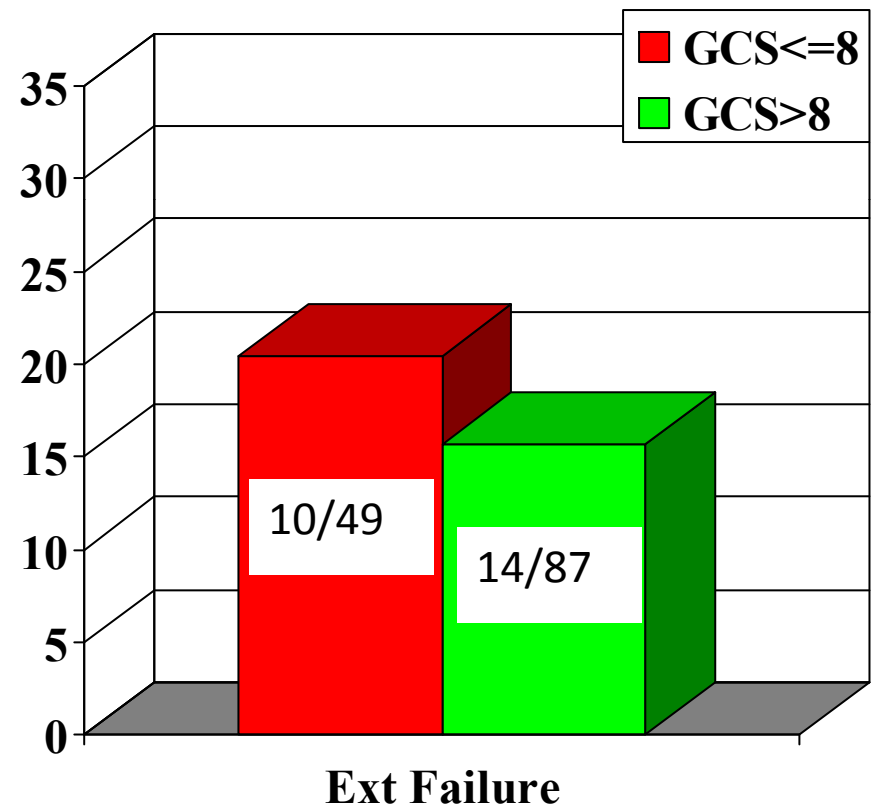
- **Coller** ATS 2003, **Delirium**
 - Delirium, trend toward EF: (16 v 8%, p=0.07)
- **Vidotto**, Neurocrit Care 2008, **GCS \geq 8**
 - GCS (10-11T) 10/83 (12%) v. GCS (8-9T) 5/9 (55%)
 - Sens 0.33, Spec 0.95, LR pos 6.6
 - **DID NOT CONTROL FOR AIRWAY**
- **Namen**, AJRCCM 2001, **GCS**
 - GCS \geq 8, 25% v. GCS < 8, 63%
 - Sens 55%, Spec 81%, LR+ =2.9

Namen, Am J Resp Crit Care Med 2001

- GCS analysis combined reintub & death
- No time frame on reintubation
- DNR not excl
- Did not *rigorously* control for airway parameters other than intact cough and cough with suction
- Extubation w/o passing DS or SBT

Coplin, AJRCCM 2000

- Overall 24/136 (18%) reintubation
- No diff in extubation failure comparing coma to no coma
- 10/11 with $GCS \leq 4$ successfully ext



Do intubated patients need to follow commands before extubation? NO

- **Ko**, Neurocrit Care 2009, Neuro ICU
 - No diff in FOUR Score (12.5 EF v 12.1 ES)
- **Frutos-Vivar**, Chest 2006
 - No diff in ability to cooperate (POOR), 39% EF v 33% ES
- **Beurat**, ICM 2009
 - Inability to follow commands
 - Reintubation: 3/24 (12%) v 11/106 (10%)

Mokhlesi et al, Resp Care 2007

N=122 (med, surg, neuro), 16 (13%) reintub in 48h

Glasgow Coma Scale \leq 10: 6/12 **(50%) failed**

Glasgow Coma Scale $>$ 10: 10/110 (9%) failed

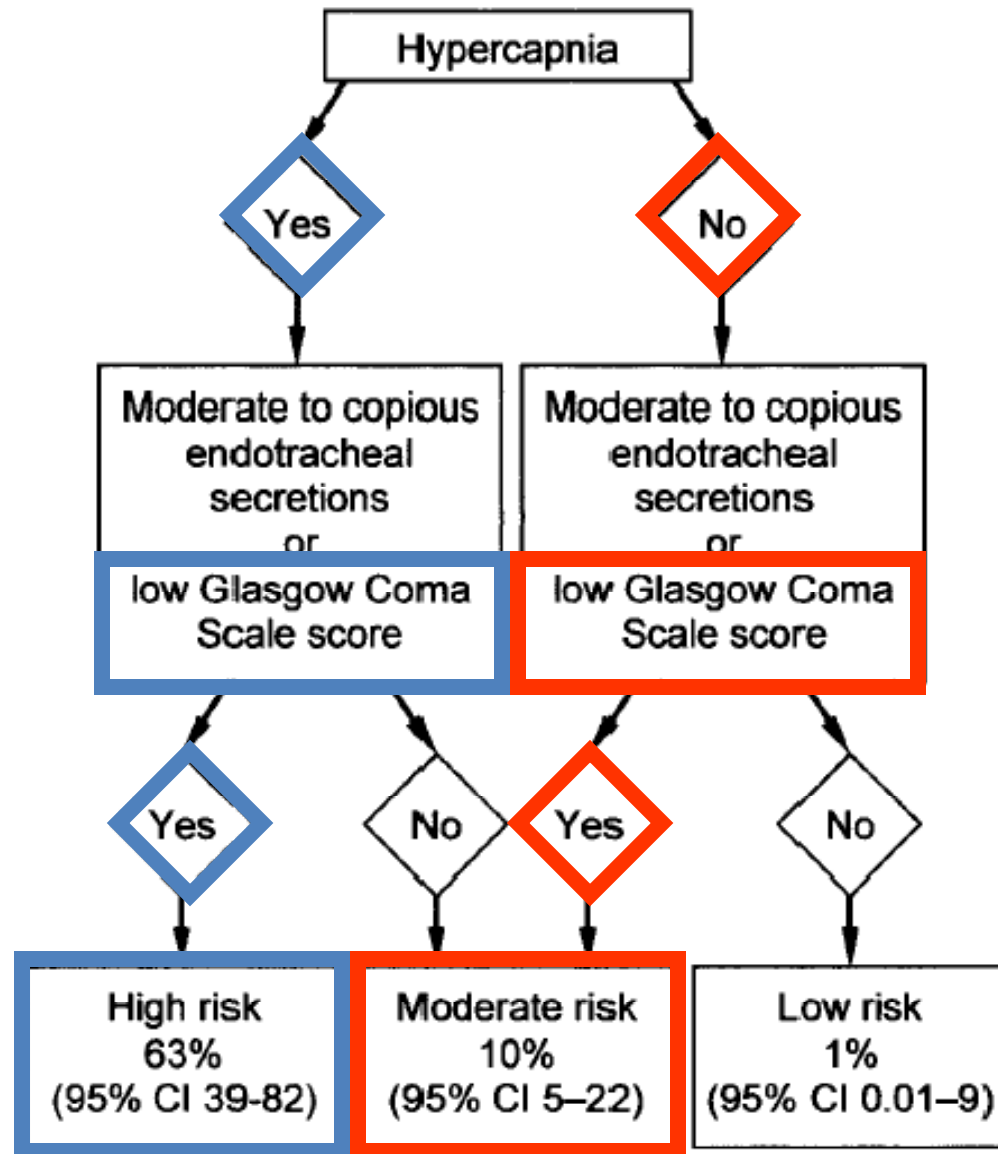
Sens 0.38, Spec 0.94, **LR pos 6.3**

Multiple Logistic Regression:

GCS \leq 10

Pre-extub PaCO₂ \geq 44 mmHg

Secretions suctioned \geq q 2h



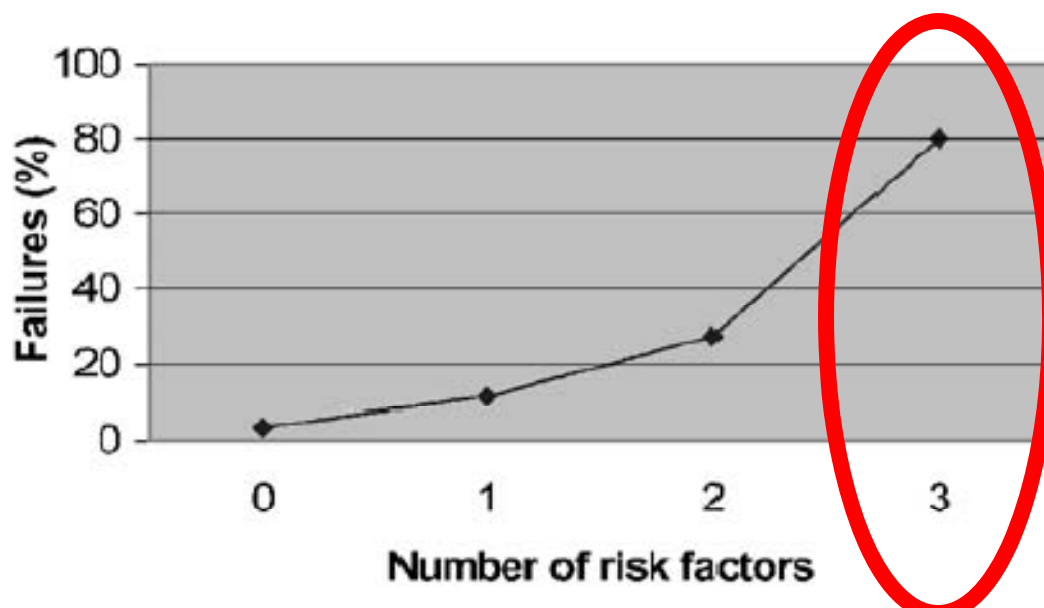
Mokhlesi et al, Respiratory Care 2007

Salam, Intensive Care Med 2004


N=88 (MICU), 14 (16%) reintub in 72h

Four Tasks: open eyes, follow with eyes, grasp hand, stick out tongue

Variable	Sensitivity (%)	Specificity (%)	Likelihood ratio	Risk ratio (95% CI)
CPF \leq 60 l/min	76.9	65.7	2.2	4.8 (1.4–16.2)
Secretions \geq 2.5 ml/h	71.4	62.0	1.9	3.0 (1.01–8.8)
<4 tasks	42.8	90.5	4.5	4.3 (1.8–10.4)



Manno et al, Critical Care 2008

- Pilot RCT, Mayo Clinic
 - 16 stable, severe brain injury, $GCS \leq 8$
 - Early v delayed extubation
 - Passed 30 min SBT + low ACS
 - **15/16 successfully extubated**
 - Mean GCS 8 (6-13)
- 

Early: Extubated if $ACS \leq 7$ and passed SBT

Delayed: Extubated if above and $GCS > 8$ for ≥ 12 h

ACS= cough to suction, sputum quant, sputum char, sputum viscosity, suction freq (all 0-3 pts)

Navalesi et al, Crit Care Med 2008

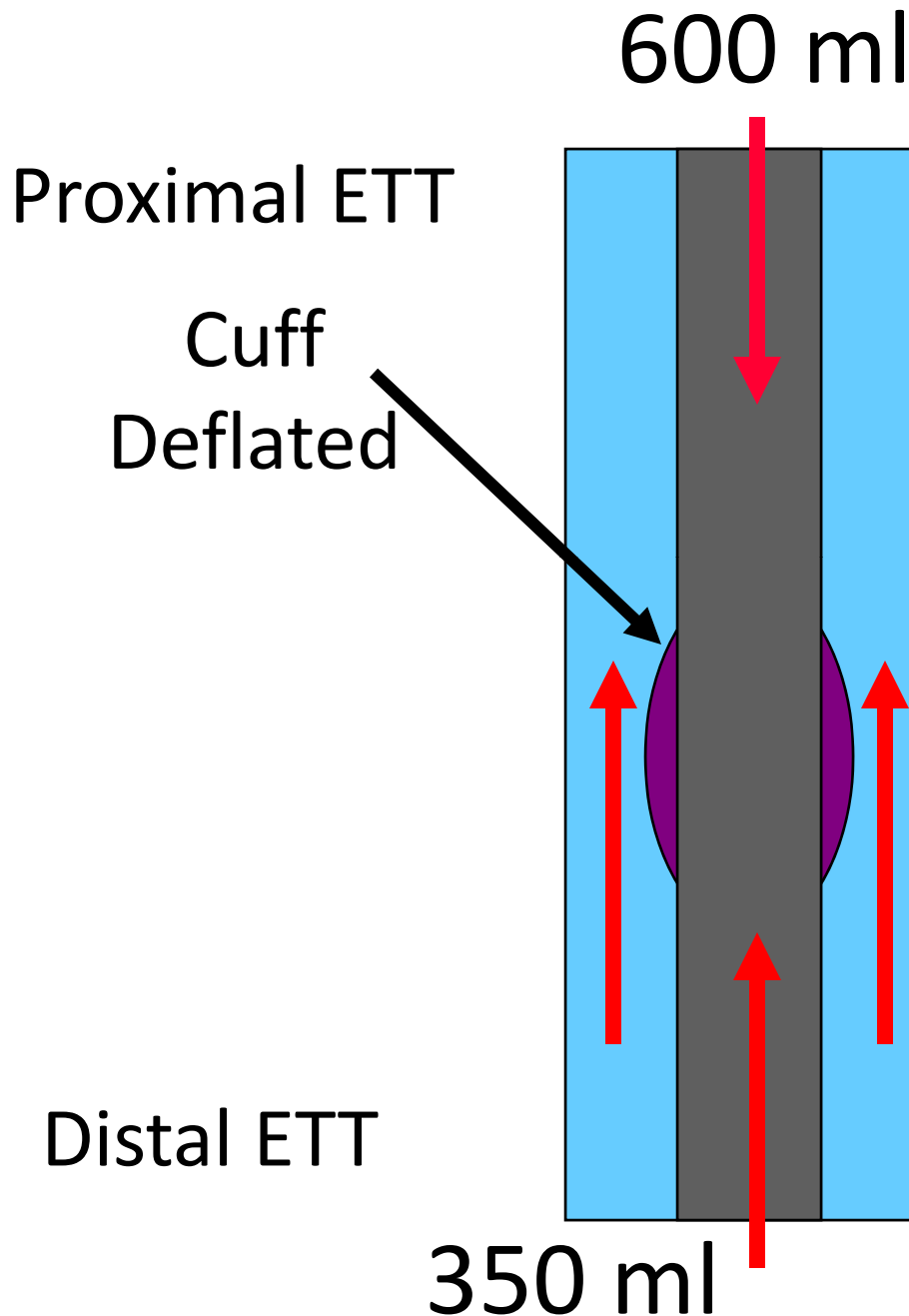
- Randomized controlled trial
- N=318, Neurologic and Neurosurgical
- Daily Screen
 - GCS \geq 8
 - Cough (audible during suctioning)
 - Suction > every 2 hours
- Reintubation (**5% v. 12%**)
- **No difference in GCS (10.6 v 10.5)**

Can we extubate patients with a positive (reduced) cuff leak test?

- Upper Airway Obstruction (UAO)
- Laryngotracheal injury
 - Inflammation, mucosal ulceration, edema, granulation tissue
 - Glottic, subglottic narrowing
- UAO in 5-35% of extubated patients
- Reintubation required in less than half
 - Some studies < 10%

Risk Factors for Post-Extubation UAO

- Female patient(e.g. small tracheal diameter)
- Trauma to upper airway
 - Multiple intubation attempts, recent unplanned extubation
- Endotracheal tube
 - Excessively mobile or overly large endotracheal tube size
 - Ratio of endotracheal tube size to laryngeal diameter > 45%
 - Excess endotracheal tube cuff pressure
 - Decreased ratio of patient height to tube diameter (e.g. large tube diameter placed in a short patient)
- Increased duration of intubation (e.g. greater than six days)
- Tracheal infection



Quantitative Cuff Leak

Comparison of insp and exp
VT with cuff down during
ACV (*Miller, Chest 1996*)

Positive CLT = min
leak/absence of leak

Prediction: UAO versus
Reintubation

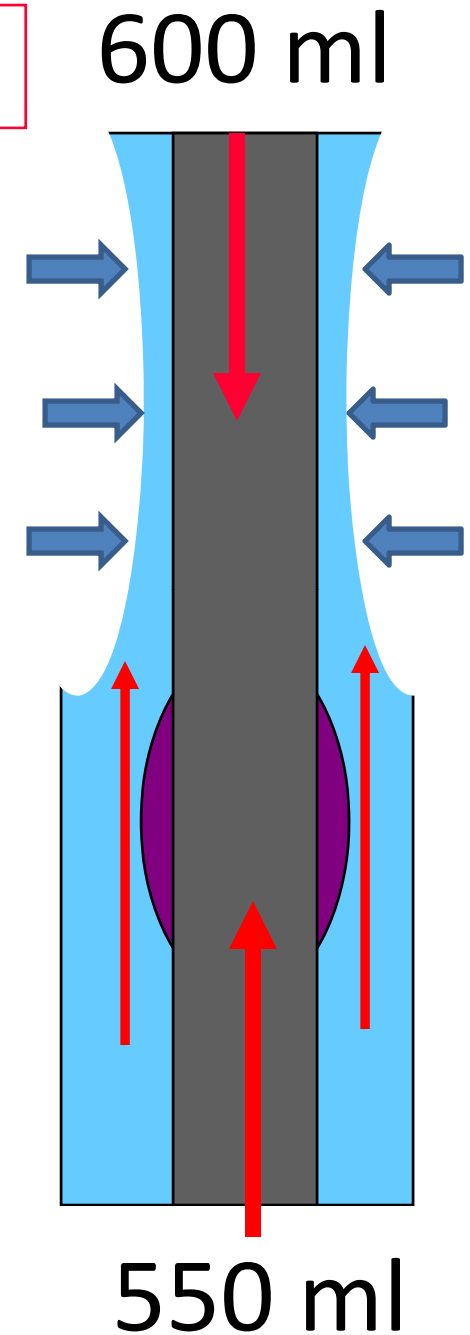
UAO = inspiratory stridor
(most studies)

UAO = laryngeal edema by
bronchoscopy (*Chung, Crit
Care Med 2006*)

$$CLV_{meas} = 250$$

$$CLV_{\text{meas}} = 50 \text{ ml or } 8\%$$

- Miller, Chest 1996: **<110 ml**
- Sandhu, JACS, 2000: **< 10%**
- De Bast, ICM, 2002: **< 15.5%**
- Jaber, ICM, 2003: **<130 ml or 12%**
- Kriner, Resp Care 2005: **<110 ml or <15%**
- Chung CCM 2006: **< 140 ml**
- Wang, CGMJ 2007: **< 88 ml or < 18%**
- Many false positive tests = No cuff leak detected but extubation still successful (Engoren 1999, Kriner 2005)
- Some false negs = Cuff leak but stridor



Proximal ETT

600 ml (inspired)

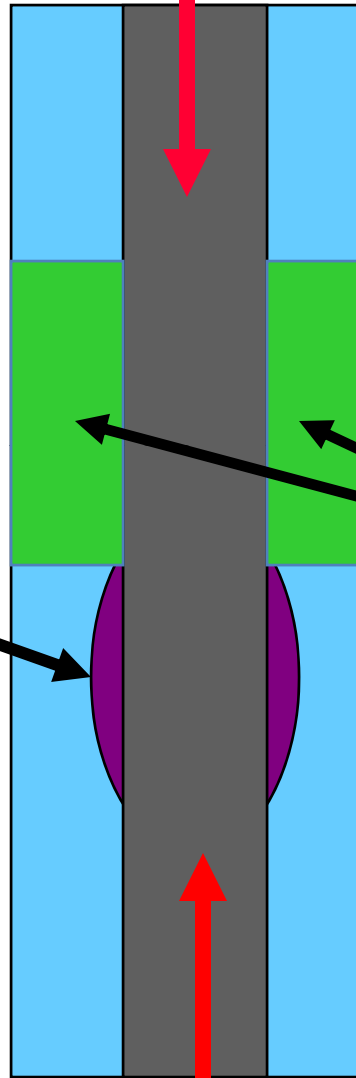
$$CLV = 0$$

Cuff
Deflated

Secretions

Distal ETT

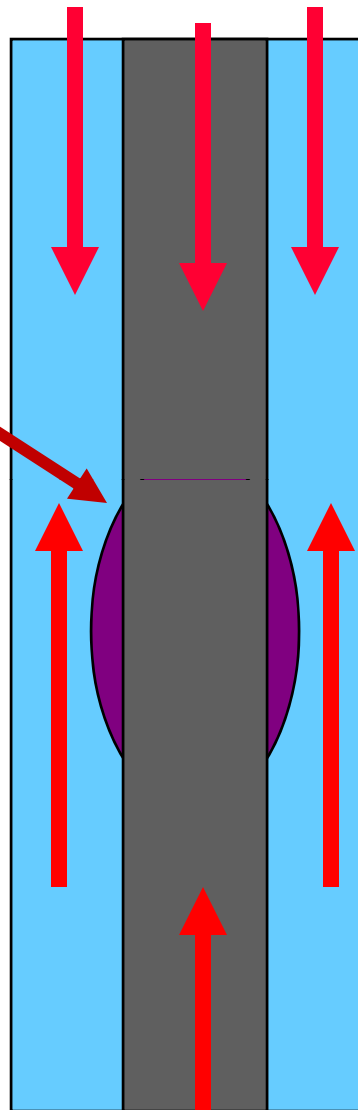
600 ml (expired)



Proximal ETT

600 ml + 300 ml

Cuff
Deflated



$$CLV_{\text{meas}} = 50$$

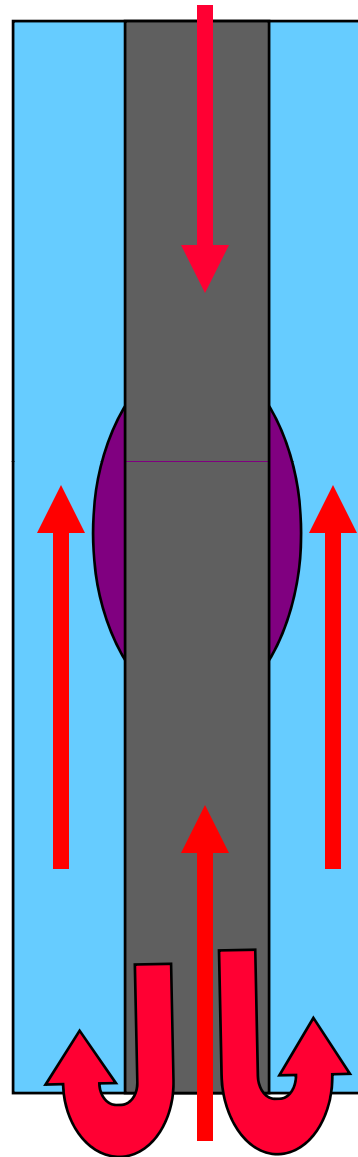
$$CLV_{\text{actual}} = 350$$

Distal ETT

550 ml

Proximal ETT

400 ml

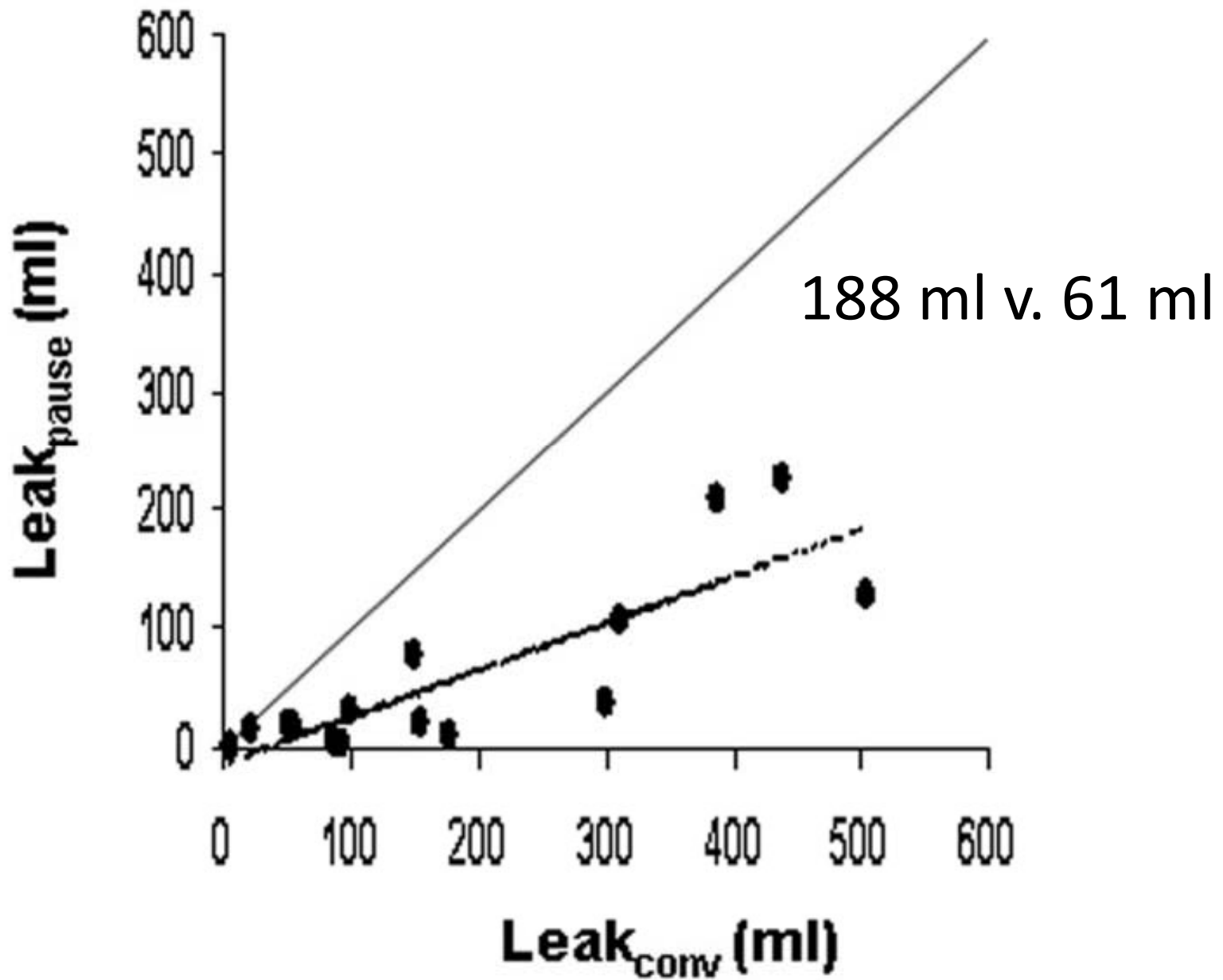


$$CLV_{\text{meas}} = 250$$

$$CLV_{\text{actual}} = 50$$

Distal ETT

350 ml



Prinianakis et al, Critical Care 2005

Systematic Review, Meta-analysis

- Ochoa et al, Intensive Care Med 2009
- 11 studies, qualitative CLT
- Heterogeneity
- UAO (9 studies)
 - Pooled sensitivity 0.56, specificity 0.92, LR+ 5.9
LR – 0.48
- Reintubation from UAO (3 studies)
 - Sens 0.63, Spec 0.86, LR+ 4.04, LR- 0.46

Steroids to prevent post-extubation UAO

- Cheng, *Crit Care Med* 2006;34:1345
 - CLV \leq 24%, Methylprednisolone 40 q 6 x 4
 - ↓ **Stridor (7 v 30%), Reintubation (7 v 19%)**
- Lee, *Crit Care* 2007;11:R72
 - CLV < 110 ml, Dexamethasone 5 q6 x 4
 - ↓ **Stridor (10 v 27%), Reintubation (2.5 v 5%)**

Steroids to prevent post-extubation UAO - Meta-analysis

- Jaber, *Crit Care* 2009; 13:R49-59
- 5 RCTS + 2 abstracts, N=1846
- Corticosteroids
 - ↓ Risk of stridor (RR 0.48)
 - ↓ Risk of reintubation (RR 0.58)
 - Strongest for CLV
 - Stridor 35% v 19%
 - Reintubation 20% v 9%
 - No clear benefit if CLV is okay

Controversies in Extubation

- Do intubated patients need to follow commands before extubation?
 - **NO**, as long as airway parameters are okay
- Can we extubate patients with a positive cuff leak test?
 - **YES**, but delay extubation for 24 hrs
 - Intravenous corticosteroids